

# **A Hung-like model of local resonance in**

## **two dimensional phononic crystal**

Han Xiaoyun, Wen Xisen, Cail Li, Zeng Chun, Yuan Xiaodong,  
Zhao Xun, Xie Kai, Yuan Naichang  
PBG Research Centre, National University of Defense Technology,  
Changsha 410073, P.R. China

A new area of research has been opened in the field of phononic crystals since the recent work of Liu et al. [1] who, based on the idea of localized resonant structures, demonstrated the existence of spectral gaps at extremely low frequencies (2 orders of magnitude smaller than the Bragg frequency associated to the lattice constant). It makes such a composite an interesting material for blocking low frequency sound. Such an effect is manifest in the electromagnetic frequency response of ionic crystal with optical vibration, which is described by Huang Equation. In our work, an analytic Hung-like model is proposed to describe the physical insight of local resonance, that is the scattering due to the coupling between vibrations of the microstructure and the long-wavelength elastic waves.

An SH wave scattering problem was considered for a hard circular cylinder coated with a soft cladding and embedded in a linearly elastic medium of infinite extent [2]. The scattering cross section and the field distribution were analysed. From the peaks in the dependence of scattering cross section on  $\omega$ , intensive scattering phenomenon were observed at the resonant frequencies of the microstructure, where the size of the scatterers were much smaller than the wavelength of the incident wave. The position of those peaks were consistent with the bottom of the spectral gaps at low frequencies. The abnormal disperse relation and negative effective elastic constants were also obtained from the Hung-like model, and the relations were discussed between the field distributions of the diffusion and the localized resonant behaviors. The results were compared with previous studies [3] and were agree well.

[1] Z. Liu et, Xixiang Zhang, Yiwei Mao, Y. Y. Zhu, al., Science 289, 1734 (2000).

[2] Liang-Wu Cai, J. Acoust. Soc. Am., 115, 515 (2004)

[3] C. Goffaux, J. Sanchez-Dehesa, Phys. Rev. B. 67, 1443 (2003)